



THE UNIVERSITY *of* EDINBURGH

Edinburgh Research Explorer

Impact of anti-discrimination laws on credit scoring

Citation for published version:

Andreeva, G, Ansell, J & Crook, J 2004, 'Impact of anti-discrimination laws on credit scoring', *Journal of Financial Services Marketing*, vol. 9, pp. 22-33. <https://doi.org/10.1057/palgrave.fsm.4770138>

Digital Object Identifier (DOI):

[10.1057/palgrave.fsm.4770138](https://doi.org/10.1057/palgrave.fsm.4770138)

Link:

[Link to publication record in Edinburgh Research Explorer](#)

Document Version:

Publisher's PDF, also known as Version of record

Published In:

Journal of Financial Services Marketing

General rights

Copyright for the publications made accessible via the Edinburgh Research Explorer is retained by the author(s) and / or other copyright owners and it is a condition of accessing these publications that users recognise and abide by the legal requirements associated with these rights.

Take down policy

The University of Edinburgh has made every reasonable effort to ensure that Edinburgh Research Explorer content complies with UK legislation. If you believe that the public display of this file breaches copyright please contact openaccess@ed.ac.uk providing details, and we will remove access to the work immediately and investigate your claim.



Impact of anti-discrimination laws on credit scoring

Received (in revised form): 12th December, 2003

Galina Andreeva

is a research student studying at the University of Edinburgh the use of generic models for revolving credit across European countries. Her current research interests are credit scoring, survival analysis and generic modelling across geographic regions.

Jake Ansell

is a senior lecturer at the University of Edinburgh specialising in customer segmentation and propensity modelling. His current interests are modelling of customer behaviour based on information retained by financial institutions.

Jonathan Crook

is Professor of Business Economics at the University of Edinburgh and specialises in credit scoring, and the demand and supply for credit and credit constraints. His current research focuses on reject inference and consumer search for low interest rates.

Abstract The political desire for further integration within the European Union will have an increasing effect on the financial services industry, including banking and credit lending. Harmonisation can potentially have great benefit for consumers as the European banks compete for their business across the Union. Harmonisation, however, brings with it a set of decisions for both credit grantors and regulators. There are issues associated with information that can be used in risk assessment to ensure fair decisions in granting credit. In the past the rules have been developed under national legislation. EU directives seek to harmonise the national rules and provide a new guidance on variables that may be held. The major concern relates to the issue of discrimination. The aim of the law is to promote the principle of equal treatment, which can be interpreted in a number of ways. The legal interpretation of discrimination does not necessarily coincide with the economic standpoint. Furthermore, previous empirical research suggests that prohibition of variables may not only affect the ability to distinguish between good and bad risk, but may also be disadvantageous to the groups the legislation is supposed to protect. This paper explores these issues from both theoretical and practical points of view.

Keywords European Union harmonisation, credit scoring, anti-discrimination laws, regulation

INTRODUCTION

A single market implies that eventually services offered will be available across all national boundaries with the European Union (EU). This requires political negotiation to establish an acceptable level of consumer protection across the EU, including equal treatment of credit

applicants. Equal treatment implies not discriminating against specified groups. This is established through Article 12 EC that proclaims non-discrimination on the grounds of nationality, and Article 13 EC that lays the foundation for combating discrimination based on sex, racial or ethnic origin, religion or belief, disability, age or sexual orientation. At the same

Galina Andreeva
Management School,
The University of Edinburgh,
50 George Square,
Edinburgh, EH8 9JY, UK
Tel: +44 131 651 1235;
Fax: +44 131 668 3053;
e-mail:
G.Andreeva@ed.ac.uk

time the Basel Banking Agreement requires appropriate systems for granting credit and assessing the liability. This has added an impetus to the use of credit scoring providing a systematic approach to the granting of credit.

Credit scoring provides an assessment of the probability of an applicant defaulting on credit. Usually based on computational approaches using historic data on previous borrowers, it relates various characteristics of the applicant to the creditworthiness or probability of default of an individual. Individuals become classed as ‘good’ — do not default — or ‘bad’ — default. The approach constructs a ‘scorecard’, which is the sum of weights assigned to the specific characteristics of the individual. The characteristics are variables either supplied by the application form or from credit reference agencies (CRA). The former consists of sociodemographic data, such as age, residential status, occupation and income, while the latter covers previous credit history: total amount of debt, any past defaults or delinquencies. Credit scoring implicitly means that a population is divided into two groups: good payers and bad payers. Hence by its nature it is discriminatory. Regulators clearly become concerned if such division is discriminatory against some groups within society protected by law.

Legislation already exists at national level within the European Union to promote social justice policies and to ensure appropriate handling of confidential personal information. It has the effect of prohibiting the use of certain variables in credit scoring. More recently, EU directives have reinforced these statutes of member states (MS), for example Article 13 which is being implemented through a set of directives. This paper explores the impact of these legal restrictions on both lenders and borrowers. In the past there has been considerable research in the USA on anti-discrimination credit regulation

but there has been insufficient research focused on the European context. The authors argue that although the US and EU legislation is different, it is possible to draw quite strong parallels and that is why lessons learned in the US environment are relevant for Europe.

Among the lessons learned the authors would like to emphasise the following insights:

- What constitutes discrimination in the legal sense may not necessarily be regarded as such from the economic point of view
- There is evidence to conclude that legal restrictions on the credit scoring models lead to reduction in their predictive ability
- The benefits for disadvantaged groups are more of political value than of practical character
- While the law seeks to eliminate both direct discrimination (making a distinction between people on prohibited grounds) and indirect discrimination (inequality in the outcome for different groups), in application to credit scoring it is only possible to rule out either direct or indirect discrimination, but not both.

The paper illustrates that these arguments can be extended into the EU environment and explores the situation when ‘nationality’ cannot be used as one of the variables in credit scoring models.

The paper explores both the theoretical and practical issues associated with discrimination in credit risk assessment and highlights some controversies and gaps in the existing legislation. The next section discusses the concept of discrimination and provides an overview of anti-discrimination regulations in the USA and EU. The following section demonstrates that the removal of prohibited variables does not necessarily eliminate

discrimination. The paper then explores the effect for both the lender and the borrower of the anti-discrimination legislature. Finally, the paper investigates the effect that the removal of 'nationality' may have on the acceptance for credit of people of different nationalities. Conclusions are then drawn.

DISCRIMINATION

By its nature credit scoring implies selection and hence discrimination. For the selection process to become illegal '... there must first be a law, and this must define the prohibited grounds of action, the person protected by the law, and the circumstances in which they are protected'.¹ Nation states have developed their own legislative approaches. Tables A1 and A2 provide a summary of the national diversity in the prohibition of variables and the scope of the application of the law (see Appendix). In the USA the legislation has been directed specifically at discrimination in credit markets whereas in the European Union the legal constraints arise from general anti-discrimination provisions covering other areas apart from credit.

In the USA the Equal Credit Opportunity Act (ECOA) prohibits characteristics from being used in credit scoring that lead to discrimination on the basis of race, colour, national origin, age, gender, marital status, religion, receipt of public assistance, or exercise of rights granted by consumer protection statutes. ECOA distinguishes between judgmental and statistical scoring, and allows the use of age in the latter provided it does not lead to the disadvantage of applicants over the age of 62.

In the US regulations the distinction is made between:

- overt discrimination: explicit use of forbidden variables in scoring models

- disparate treatment: judgmental or subjective discrimination, which may occur when the score derived from the statistical model is judgmentally adjusted
- the disparate impact, which occurs when the model does not contain prohibited variables but leads to excessive rejection of borrowers of a certain race or gender. In this case, the lender needs to show there is a 'business necessity' for using particular variables and there is no equally effective way of making the credit decision.²

In the EU the legal constraints on consumer credit follow from:

- treaties: the aforementioned Articles 12 and 13 EC, and Article 3 EC that proclaim equality between men and women³
- Directive 2000/43/EC of June 2000 implementing the principle of equal treatment between persons irrespective of racial and ethnic origin. The Directive goes beyond the labour market, covering the 'access to and supply of goods and services which are available to [the] public'
- Data Protection Directive.⁴ The clause concerning sensitive data imposes prohibition on processing of information 'revealing the racial or ethnic origin, political opinions, religious or philosophical beliefs, trade union membership, health or sex life [of the public] with some exemptions.

In general, EU law provides some minimum standards and requirements, so that member states cannot go below them, but can go above. And some EU states do go further and adopt more stringent anti-discrimination regulations than the EU laws. Austria, Italy, the Netherlands and the UK have acts that outlaw discrimination in access to services and

goods on grounds wider than race and ethnic origin. For example, in the UK discrimination is forbidden not only on the grounds of race, but also on the grounds of sex, disability, religion and belief.

Even 'racial grounds' have a broader scope: the UK 1976 Race Relations Act⁵ covers the grounds of race, colour, nationality (including citizenship), ethnic or national origin. The Act declares unlawful 'segregating a person from other persons on racial grounds' or in other words, direct discrimination. This is equal to overt discrimination in the USA or prohibition to use the previously listed variables in scoring models. At the same time the Act states that even when any requirement is applied equally to all persons, but 'the proportion of persons of the same racial group as that other who can comply with it is considerably smaller than the proportion of persons not of that racial group who can comply with it', this also constitutes discrimination. So if the members of an ethnic group have lower incomes, shorter terms of living at the same address or working in the same job, compared to other ethnic groups, and these variables are included into credit risk assessment, and therefore, members of the disadvantaged group are granted less credit, this also constitutes discrimination, unless it can be shown that the requirement is 'justifiable'.

Furthermore, the recent amendment of the said Act which followed the implementation of the EU Race Directive, states that even if the requirement is applied equally to all persons, but members of a certain ethnic group would be at a disadvantage, then it is necessary to show that this requirement constitutes 'proportionate means of achieving a legitimate aim'. In principle, this echoes the disparate impact of the US regulations.

The above describes the legal position in terms of discrimination. From an

economic viewpoint there are generally two meanings: taste-based discrimination, which can be deemed subjective and statistical discrimination, which can be deemed objective. Taste-based discrimination arises from preferences or prejudice and according to Becker⁷ and Peterson and Peterson⁸ the person must pay extra in order to have the privilege of not dealing with certain groups. It is assumed there exists a point beyond which it becomes too expensive to discriminate. This leads to the conclusion that by the operation of market forces the discrimination will eventually be eliminated.

Statistical discrimination arises from the lack of information necessary to calculate the degree of risk.^{9,10} It is assumed that individuals will behave like the group of which they are members, since there is insufficient information on the individual. Hence the risk estimate for the group is attributed to the individual and this may lead to differential behaviour with respect to the individual. This can be regarded as objective risk, but is still discriminatory against the individual based on the assumed group behaviour. So if the historic credit behaviour of a group is poor then it is deemed that individuals from the group will have a higher probability of default in the future. The lender might reasonably argue that this type of discrimination is economically rational and hence market forces will not eliminate the discrimination. It would constitute discrimination if members of a demographic group are more likely to be rejected by the lender than those from other groups with similar characteristics besides group membership.¹¹ Hence the membership of the group is influencing the default probability.

Avery¹⁰ differentiates this form of discrimination into two types: the 'endowment' effect and the 'mean shift' effect. The endowment effect results from

a difference in the economic variables between the groups and hence it can be argued that it does not constitute discrimination but a response to these differences. The mean shift effect describes those cases where group membership provides information about default beyond that supplied by the economic variables. Practically, though, it will be shown in the next section that it is not possible to differentiate between these two effects since often group membership is correlated with economic measures.

All three forms (taste-based, endowment effect and mean shift) are subject to legal restrictions. If the information about group membership is being used within the decision-making process then there is direct discrimination, which is illegal, regardless of whether it is based on subjective judgment or statistical modelling. If there is a difference in the acceptance rates, it constitutes indirect discrimination, and whether it is legal or not is open to interpretation by the law-enforcement authorities, as will be shown below.

PROHIBITION DOES NOT RESOLVE DISCRIMINATION

Initially it was assumed that all that was necessary to avoid discrimination was to ensure that the variables indicating membership of specific groups should be removed. Unfortunately it is not as simple as this. Illustrations of this effect are easier to obtain from US data since their laws require disclosure of information on performance of specific groups. For example the Home Mortgage Disclosure Act (HMDA) requires data on race to be disclosed on loans granted and loans denied.

Munnell *et al.*¹² using the HMDA data in the Boston area found that black and Hispanic applicants were nearly three times as likely to be denied credit as white

applicants. Also those applying for properties in areas with a higher percentage of blacks and Hispanics were more likely to be rejected. That led to the accusations that bankers were using race as a variable in the credit granting process. These findings, though, were criticised by a number of statisticians and economists.^{11,13–15} As indicated by Yinger¹¹ there are methodological difficulties in estimating the importance of the 'race' coefficient since many of the applicants' characteristics are correlated with race. If any of these variables are missing then the estimate of the 'race' coefficient will be affected with the possibility of it being overestimated. This is referred to as omitted-variable bias.

To overcome this criticism Munnell *et al.*¹⁶ included 38 additional variables, which comprehensively covered all possible factors that lenders used for predicting default. In doing so they reduced the relative rejection ratio for blacks and Hispanics and whites from 2.8 to 1 down to 1.8 to 1. The new study also found that there was no evidence of discrimination due to racial composition of the area.

Yinger¹¹ also suggested further concerns about the estimation of significance of discrimination. Bostic¹⁷ had found that the race indicator was significantly correlated with the economic variables used by Munnell's analysis and that there was significant difference in the economic measures between the populations. Bostic went further, to suggest that one could not claim discrimination was a general phenomenon, since the differences in probability only existed for a marginal applicant with low economic and poor credit history and that one could not determine whether the discrimination was occurring because of race or on economic grounds.

The study shifted the attention of US legislators towards indirect discrimination,

since although race was removed from the decision-making process, the inequality in the outcome of the decision remained. For example, Crook¹⁸ in the analysis of US household debt established that being black increases the chance of being credit constrained. The use of specific variables in the credit scoring system is justified if it is statistically related to loan performance and has an 'understandable relationship' to the applicant's creditworthiness.¹⁹ There clearly is considerable debate over the subjective concept of 'understandable relationship'.

In the EU, indirect discrimination 'can be objectively justified by a legitimate aim' if 'the means of achieving that aim are appropriate and necessary'. In application to credit scoring, this statement can be interpreted in a number of ways, since on the European level there is no explanation of which means are appropriate and necessary in credit risk assessment.

In the UK this problem is partially resolved by the Guide to Credit Scoring²⁰ compiled by the credit industry and approved by The Office of Fair Trading and Department of Trade and Industry. Although this document lays down the principles of appropriate standards for credit risk assessment, it is not legally binding. Para 2.4 of the Guide states that 'Credit Scoring will not discriminate on the grounds of sex, race, religion, disability or colour'. It is not clear whether the statement covers direct or indirect discrimination or both.

IMPACT ON CREDIT GRANTING

The prohibition of direct discrimination provides no guarantee against the discrepancy in acceptance rates between different sociodemographic groups. If the equality in outcome of the decision is to be achieved then some provisions against indirect discrimination should be made. In fact, it can be shown that the prohibition

of direct discrimination alone can work against both lenders and borrowers. It can also be shown, however, that in the context of credit scoring it is impossible to satisfy the requirement to eliminate both direct and indirect discrimination.

Before approaching the question of the impact of legal constraints on lenders and borrowers, it is necessary to establish whether the prohibited variables are related to the default probability and in what way. Intuitively one may feel that there is a relationship between the prohibited variables and the default probability, otherwise there is no point in prohibition. There is also some empirical evidence available, however, predominantly from the US environment.

A number of studies^{21–25} found that women and older borrowers were less risky than other borrowers. So one can argue on the basis of this research that some protected classes are actually *more* creditworthy than some unprotected groups. But in contrast to older age and gender, the evidence on relationship between race and default appears to be controversial. Elliehausen and Durkin²⁶ argue that racial minorities do have a higher probability of default based on the findings of Avery²⁵ and Boyes *et al.*²⁴ The recent study by Martin and Hill²⁷ provides further evidence of higher default rates for racial minorities. On the other hand, Munnell *et al.*¹⁶ refer to Van Order *et al.*²⁸ who found the contrary evidence for some parts of the USA.

If there is a relationship between prohibited variables and default probability, the implications for lenders are straightforward: if they cannot find legally acceptable substitutes for prohibited variables the predictive ability of models (the ability to distinguish between good and bad credit risks) will deteriorate, and lenders will incur loss.

A study on the effect of limiting information in credit scoring models was

carried out by Shinkel.²⁹ He developed eight discriminant models, from which seven models excluded attributes prohibited by the ECOA and one model contained the prohibited variables. His results indicated that exclusion of prohibited variables reduced the number of good loans accepted (0.3–2.3 per cent) and increased the number of bad loans accepted (0–2.6 per cent) with a reduction in profitability of 2–16 per cent.

On the other hand, Elleihausen and Durkin²⁶ refer to studies that demonstrated the opposite result,^{30,31} which concluded that there were no significant differences in predictive ability with and without gender, marital status and age. It was noted, however, that both data sets excluded rejected applicants from their analysis. Another possible reason for getting such results is the possible presence of variables strongly correlated with the excluded ones, so that the variables remaining in the model ‘proxy’ the prohibited ones.

At the same time, there is no evidence to prove that prohibition of certain characteristics increased the acceptance rates for protected groups. The analysis by Chandler and Ewert²² suggests that separate risk profiles for male and female applicants may identify credit risk more precisely than a model which ignores applicants’ gender or one which allows for only limited differences in male and female risk profiles. And what is more important, the acceptance rates for females are higher when the sex is included in the model. So one can conclude that ECOA appeared to

disadvantage rather than benefit female applicants.

From theoretical consideration it is possible to show that if scorecards are built for separate sub-groups within the population then the sub-population scorecards tend to reject fewer applicants than full population scorecards. That follows from the Yule-Simpson paradox.^{32,33} The paradox arises when the relationship between the outcome and predictor variables changes depending on the value of a third variable. Examples of the Yule-Simpson paradox abound in medicine.^{34–37}

To illustrate the Yule-Simpson paradox when applied to consumer credit, consider the following example, which is totally hypothetical. Table 1 gives the breakdown of accepted applications by sex, employment status and outcome. The numbers in parenthesis are probabilities of being ‘good’ given employment status.

Whereas both male and female applicants with full-time jobs are better credit risks, the part-time status appears to be associated with more creditworthy behaviour, if no distinction between sexes is made. This example illustrates that although women are better credit risks than men, they are not ‘rewarded’ for this in the ‘sexless’ scorecard.

Yule-Simpson’s paradox arises because the combined probabilities are averages weighted by the fraction of each sex. Since a greater proportion of those with part-time status is women, more weight is given to women in the combined probability for part-time status. On the

Table 1 Number of accepted cases by applicant’s sex and employment status

		<i>Applicant’s sex</i>					
		<i>Male</i>		<i>Female</i>		<i>Combined</i>	
Outcome		Good	Bad	Good	Bad	Good	Bad
Employment status	Full-time	130 (0.62)	80	30 (0.75)	10	160 (0.64)	90
	Part-time	40 (0.57)	30	130 (0.72)	50	170 (0.68)	80

contrary, the full-time marginal probability reflects the male dominance in this employment category. This situation can be easily remedied either by segmentation or stratification, but if there are legal restrictions on the use of sex in a scorecard, this does not appear possible. Therefore, the inability to distinguish between different sub-groups makes the lenders apply one generalised scale to all applicants, which is detrimental to both lenders and borrowers. Furthermore, if protected groups constitute the minority in overall population, they will be assessed on the white male scale simply because their characteristics will be given less weight in the statistical analysis. It may sound paradoxical, but in order to eliminate discrimination in the social sense, it is necessary to discriminate in the statistical sense.

NATIONALITY

In the European context Platts and Howe³⁸ found that the predictive power of the model decreases when no distinction is made between nationality or country of residence. And nationality is one of the variables that comes under the scrutiny of European law. In France the national data protection authority, Commission National de l'Informatique et des Libertés (CNIL), explicitly prohibited the use of nationality in credit scoring models in 1998.³⁹ Recently, however, this decision was overruled by a higher authority.⁴⁰

Andreeva *et al.*⁴¹ using data on a retail card from three countries, have demonstrated that exclusion of nationality in a generic model will discriminate against certain groups. Combining data from Belgium, Germany and the Netherlands it was found that the rejection rate for the Netherlands increased in the generic model compared to the models constructed for the individual countries. This disproportion in response would

Table 2 The percentage change in those accepted and those rejected using a generic model rather than a national model

Country	Percentage difference
Belgium	3.83
Germany	2.75
The Netherlands	3.82

constitute discrimination. Also the study illustrated the difficulty in ensuring equality of treatment using different models. Using the same level of cut-off within the samples the change between the groups who would receive credit and those who would not using a generic model against a national model is presented in Table 2.

CONCLUSION

It appears that the anti-discriminatory legislation works against at least some protected groups. It fails to ensure greater access to credit for disadvantaged groups, but at the same time it leads to deterioration of the predictive power of scoring models, which in turn results in an increased number of bad risks that were granted credit, when good risks were denied it, making credit more expensive.

The drive towards integration within the European Union means that there has been increasing desire to create harmonisation. This has an impact on many aspects. In this paper consideration has been given to the impact of anti-discrimination legislation on credit scoring. The aim of the legislation is to develop equitable treatment of individuals. It is currently perceived that this legislation would achieve this through the elimination of both direct and indirect discrimination. Unfortunately, these dual targets within the context of credit scoring seem mutually exclusive. If the use of certain characteristics is prohibited (direct discrimination), then the protected groups

are very likely to suffer from indirect discrimination. This arises since the group may suffer higher economic disadvantage and so a higher probability of default. If the law wants to combat the unequal discrimination of credit (indirect discrimination), then the use of the relevant information should be allowed.

The objective of the anti-discriminatory legislation is to achieve equal treatment of individuals. Use of prohibitive information in this context is seen by some as reinforcing the distinction and is therefore politically unacceptable. It is argued by others,⁴² that all variables that are statistically valid should be used. In fact it *can be* advantageous for some groups normally thought of as disadvantaged, who might benefit. It is also possible to devise systems so that the use of such information can be advantageous, such as the suggestion by Hand⁴³ that separate models be built for sub-populations with the same proportion of rejected applications. Hence, one has ensured that credit has been extended to protected groups on an equal basis. There are, however, problems with this approach. First, the sub-populations have to be identified, which may not be easy in the case of race and ethnic origin or religion and belief. Secondly, Martin and Hill²⁷ point out the danger of general deterioration in credit quality in the long run, if more individuals are accepted with a higher likelihood of default. The resultant increase in costs and potential decrease in credit availability will have to be borne by all, including the protected groups.

Achieving equal treatment may be regarded as a positive attempt to re-address discrimination arising out of modelling. Without the resultant information discrimination will occur indirectly. Therefore retention of the information, while unpalatable, may allow action to be taken to ensure that fairness is

achieved. This makes the decision a policy action, rather than an artefact of the modelling. A balance needs to be struck between the necessity to ensure that credit is granted to those who can repay it and the necessity to protect human rights within the credit market.

REFERENCES

- 1 Banton, M. (1994) 'Discrimination', Open University Press.
- 2 Office of Comptroller of Currency Bulletin (1994), 94–30. <http://www.occ.treas.gov/ftp/bulletin/94-30att.pdf>.
- 3 Treaty (2002) 'Consolidated version of the Treaty establishing the European Community', *Official Journal of the European Communities*, C325, 33–184, http://europa.eu.int/eur-lex/en/treaties/dat/EC_consol.pdf.
- 4 Directive 95/46/EC of the European Parliament and of the Council of 24th October, 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data, (23/11/1995) L 281 *Official Journal*, pp. 31–50.
- 5 Race Relations Act (1976), <http://www.homeoffice.gov.uk/docs/part1.html>.
- 6 Statutory Instrument (2003) No. 1626. The Race Relations Act 1976 (Amendment) Regulations 2003, <http://www.hms.o.gov.uk/si/si2003/20031626.htm>.
- 7 Becker, G. S. (1971) 'The Economics of Discrimination', University of Chicago Press.
- 8 Peterson, R. L. and Peterson, C. M. (1978) 'Testing for Sex Discrimination in Commercial Bank Consumer Lending', Working Paper 10, Credit Research Center, Purdue University.
- 9 Phelps, E. S. (1972) 'The statistical theory of racism and sexism', *American Economic Review*, Vol. 62, No. 9, pp. 659–661.
- 10 Avery, R. B. (1981) 'Indirect screening and the Equal Credit Opportunity Act', Research Papers in Banking and Financial Economics, Board of Governors of the Federal Reserve System, Division of Research and Statistics, Financial Studies Section, Washington.
- 11 Yinger, J. (1997) 'Discrimination in mortgage lending: A literature review', in Goering J.M. and Wienk, R. E. (eds) 'Mortgage Lending, Racial Discrimination, and Federal Policy', Ashgate, Aldershot.
- 12 Munnell, A. H., Tootell, G. M. B., Browne, L. E., and McEneaney, J. (1992) 'Mortgage lending in Boston: Interpreting HMDA data', Working Paper 92–7, Federal Reserve Bank of Boston.
- 13 Brimelow, P. and Spencer, L. (1993) 'The Hidden Clue', *Forbes*, January, p. 48.
- 14 Liebowitz, S. J. (1993) 'A study that deserves no credit', *Wall Street Journal*, September p. A14.
- 15 Zandi, M. (1993) 'Boston Fed's bias study was deeply flawed', *American Banker*, August, p. 13.
- 16 Munnell, A. H., Tootell, G. M. B., Browne, L. E. and McEneaney, J. (1996) 'Mortgage lending in Boston: Interpreting HMDA data', *The American Economic Review*, Vol. 86, No. 1, pp. 25–53.

- 17 Crook, J. (2001) 'The demand for household debt in the USA: Evidence from the 1995 Survey of Consumer Finance', *Applied Financial Economics*, Vol. 11, pp. 83–91.
- 18 Bostic, R. W. (1997), 'The role of race in mortgage lending: Revisiting the Boston Fed Study', Finance and Economics Discussion Paper Series, 1997-02, Board of Governors of the Federal Reserve System.
- 19 Office of Comptroller of Currency, Bulletin (1997) 97–24. <http://www.occ.treas.gov/ftp/bulletin/97-24att.pdf>.
- 20 Guide to Credit Scoring (2000), <http://www.bba.org.uk/public/consumers>.
- 21 Durand, D. (1941), 'Risk Elements in Consumer Instalment Financing', Studies in Consumer Instalment Financing, 08, National Bureau of Economic Research, New York.
- 22 Chandler, G. G. and Ewert, D. C. (1976) 'Discrimination on the basis of gender under the Equal Credit Opportunity Act', Working Paper 1976–8, Credit Research Center, Purdue University.
- 23 Altman, E. I., Avery, R. B., Eisenbeis, R. A., and Sinkey, J. F., Jr. (1981) 'Applications of Classification Techniques in Business, Banking, and Finance', JAI Press, Greenwich, CT.
- 24 Boyes, W. J., Hoffman, D. and Low, S. (1978) 'Lender reactions to information restrictions: The case of banks and ECOA', *Journal of Money, Credit and Banking*, Vol. 18, pp. 211–219.
- 25 Avery, R. B. (1982) 'Discrimination in consumer credit markets', Research Papers in Banking and Financial Economics, Board of Governors of the Federal Reserve System, Division of Research and Statistics, Financial Studies Section, Washington.
- 26 Elliehausen, G. E. and Durkin, T. A. (1989) 'Theory and Evidence of the Impact of Equal Credit Opportunity: An Agnostic Review of the Literature', Monograph 28, Krannert Graduate School of Management, Purdue University.
- 27 Martin, R. E. and Hill, R. C. (2000) 'Loan performance and race', *Economic Inquiry*, Vol. 38, pp. 136–150.
- 28 Van Order, R., Westin, A. M. and Zorn, P. (1993) 'Effects of racial composition of neighborhoods on defaults, and implication in mortgage markets', Paper presented at the Allied Social Science Associations meetings in Anaheim, CA.
- 29 Shinkel, B. A. (1980) 'The effects of equal credit opportunity legislation in consumer finance lending', *Journal of Business Research*, Vol. 8, No. 3, pp. 113–134.
- 30 Shay, R. S. and Genderton, D. E. (1979) 'Anti-Discrimination Laws in Consumer Credit Markets: Their Impact on Creditors Approval of Applications', in Heggestad, A. A. and Mingo, J. J. (eds) 'The Costs and Benefits of Public Regulation of Consumer Financial Services', Abt Associates, Inc., Cambridge, MA.
- 31 Nevin, J. R. and Churchill, G. A., Jr. (1979) 'The Equal Credit Opportunity Act: An evaluation', *Journal of Marketing*, Vol. 43, No. 2, pp. 95–104.
- 32 Yule, G. U. (1903) 'Notes on theory of association of attributes in statistics', *Biometrika*, Vol. 2, pp. 121–134.
- 33 Simpson, E. H. (1951) 'The interpretation of interaction in contingency tables', *Journal of the Royal Statistical Society B*, Vol. 13, pp. 238–241.
- 34 Hand, D. J. (1979) 'Psychiatric examples of Simpson's paradox', *British Journal of Psychiatry*, Vol. 135, pp. 90–91.
- 35 Hanley, J. A. and Theriault, G. (2000) 'Simpson's paradox in meta-analysis', *Epidemiology*, Vol. 11, No. 5, p. 613.
- 36 Julious, S. A. and Mullee, M. A. (1994) 'Confounding and Simpson's paradox', *British Medical Journal*, Vol. 309, No. 6967, pp. 1480–1481.
- 37 Baker, S. and Kramer, B. (2001) 'Good for women, good for men, bad for people: Simpson's paradox and the importance of sex-specific analysis in observational studies', *Journal of Women's Health & Gender-Based Medicine*, Vol. 10, No. 9, pp. 867–872.
- 38 Platts, G. and Howe, I. (1997) 'A Single European Scorecard', Proceedings of Credit Scoring and Credit Control V, Credit Research Centre, University of Edinburgh.
- 39 CNIL (1998) 'Délibération n 98-101 du 22 décembre 1998 portant modification de la recommandation relative à la gestion des crédits ou des prêts consentis à des personnes physiques par les établissements de crédit', <http://www.cnil.fr/publi/index.htm>.
- 40 Le Conseil d'Etat (2001) 'Statuant au contentieux, sur le rapport de 10ème sous-section', N 204909, Séance du 19 Octobre 2001, lecture du 30 Octobre 2001, <http://www.conseil-etat.fr/ce-data/index2.htm>.
- 41 Andreeva, G., Ansell J. and Crook, J. N. (2003) 'Credit Scoring in the Context of the European Integration: Assessing the Performance of the Generic Models', Proceedings of Credit Scoring and Credit Control VIII Conference, University of Edinburgh.
- 42 Johnson, R. W. (1992) 'Legal, social and economic issues in implementing scoring in the US', in Thomas, L. C., Crook, J. N. and Edelman D.B. (eds) 'Credit Scoring and Credit Control', Clarendon Press.
- 43 Hand, D. J. (1998) 'Consumer credit and statistics', in Hand, D. J. and Jacka, S. D. (eds) 'Statistics in Finance', Arnold, London.

Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

APPENDIX

Table A1 Differences in legislation in the USA, EU and UK in application to credit scoring

<i>Characteristics that are legally restricted</i>	<i>USA</i>	<i>EU</i>	<i>UK</i>
Race/colour/ethnic origin	Equal Credit Opportunity Act (ECOA)	Data Protection Directive (95/46/EC), Directive 2000/43/EC on racial and ethnic origin equality/ Article 12 EC, Data Protection Directive (95/46/EC)	Race Relations Act
Nationality/country of residence			
Religion /belief	ECOA	Data Protection Directive (95/46/EC)	Human Rights Act
Health or sex life		Data Protection Directive (95/46/EC)	
Gender	ECOA	Proposal for a new gender equality Directive	Sex Discrimination Act
Age	ECOA		
Marital status	ECOA		
Politics/ trade union membership		Data Protection Directive (95/46/EC)	
Disability			Disability Discrimination Act
Third party data	Fair Credit Reporting Act	Data Protection Directive (95/46/EC)	Data Protection Act 1998
Neighbourhood characteristics	Community Reinvestment Act, Home Mortgage Disclosure Act		OFT Report 1992
Public assistance income	ECOA		
Exercise of credit consumer rights	ECOA		

Table A2 National provisions^a against discrimination on grounds of race/ethnic origin, religion/belief, disability,^b age or sexual orientation

Member state	Laws or collective agreements	Grounds covered	Scope
Belgium	Collective agreement of 6th December, 1983 concerning the recruitment and selection of workers	Racial or ethnic origin, religion or belief and age	Employment
Denmark	Act 459 of 12th June, 1996 on prohibition of discrimination in respect of employment and occupation etc	Racial or ethnic origin, religion or belief and sexual orientation	Employment
Germany	Civil Service codes and the Works Constitution Act (Betr.VG)	Racial or ethnic origin, religion or belief	Employment
Greece	No anti-discrimination law.	—	—
Spain	The Workers Statute Act ('Estatuto de los Trabajadores') ^c	Racial or ethnic origin, religion or belief and age	Employment
France	The Labour Code	Racial or ethnic origin, religion or belief, disability and sexual orientation	Employment
Ireland ^d	Employment Equality Act, 1998	Racial or ethnic origin, religion or belief, disability and sexual orientation	Employment
Italy	Law no. 300 of 20th May, 1970 (Workers Statute) and law no. 40 of 6th March, 1998	Racial or ethnic origin and religion or belief	Employment (Workers Statute) and the provision of services and goods (law no 40)
Luxembourg	No anti-discrimination law	—	—
The Netherlands ^e	The Equal Treatment Act (1994)	Racial or ethnic origin, religion or belief and sexual orientation.	Employment, advice regarding choice of education or career and provision of goods and services
Austria	The Introductory Act to the Administrative Procedures Code (<i>Verwaltungsverfahrensgesetz</i>)	Racial or ethnic origin and religion or belief.	Provision of public service and admission to public places
Portugal	No anti-discrimination law.	—	—
Finland	The Act on Contracts of Employment	Racial or ethnic origin, religion or belief, age and sexual orientation	Employment
Sweden	Employment Protection Act (1982), Ethnic Discrimination Act (1999), Act on Discrimination of people with disabilities (1999), Act on discrimination on grounds of sexual orientation (1999)	Racial or ethnic origin, religion or belief, handicap and sexual orientation	Employment
The United Kingdom	The Race Relations Act 1976 and The Disability Discrimination Act 1995	Racial or ethnic origin, religion or belief and disability	Employment, training, education, provision of goods, facilities and services, or management and disposal of premises

Notes:

^a The table does not cover the constitutional provisions. All the MS have articles in their constitutions providing for the equality principles, except for the UK that does not have a written Constitution

^b Only legislation which makes it unlawful to discriminate against disabled people is mentioned in the table. Concerning the integration of disabled people several member states have systems of compulsory employment or quota schemes (Germany, Greece, Spain, Italy, Luxembourg, the Netherlands and Austria) while others rely on subsidies to employers

^c Revised text approved by the Royal Legislative Decree N 1/1995 of 25th March 1995

^d Legislation prohibiting discrimination on the same grounds as The Employment Equality Act in education, the provision of goods and services and the disposal of property and accommodation (Equal Status Bill) was presented to the National Parliament on 15th April, 1999

^e Proposals for legislation prohibiting discrimination on grounds of age and disability is currently being prepared

Source: 'Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions on certain Community measures to combat discrimination' COM (1999) 564 final